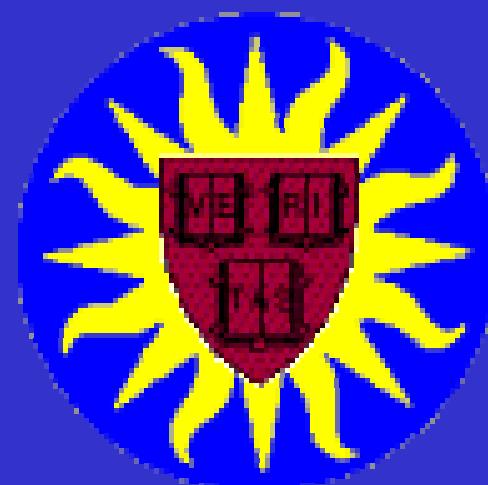
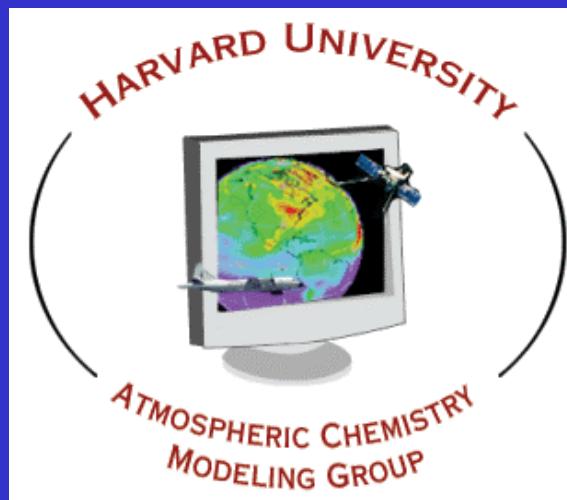


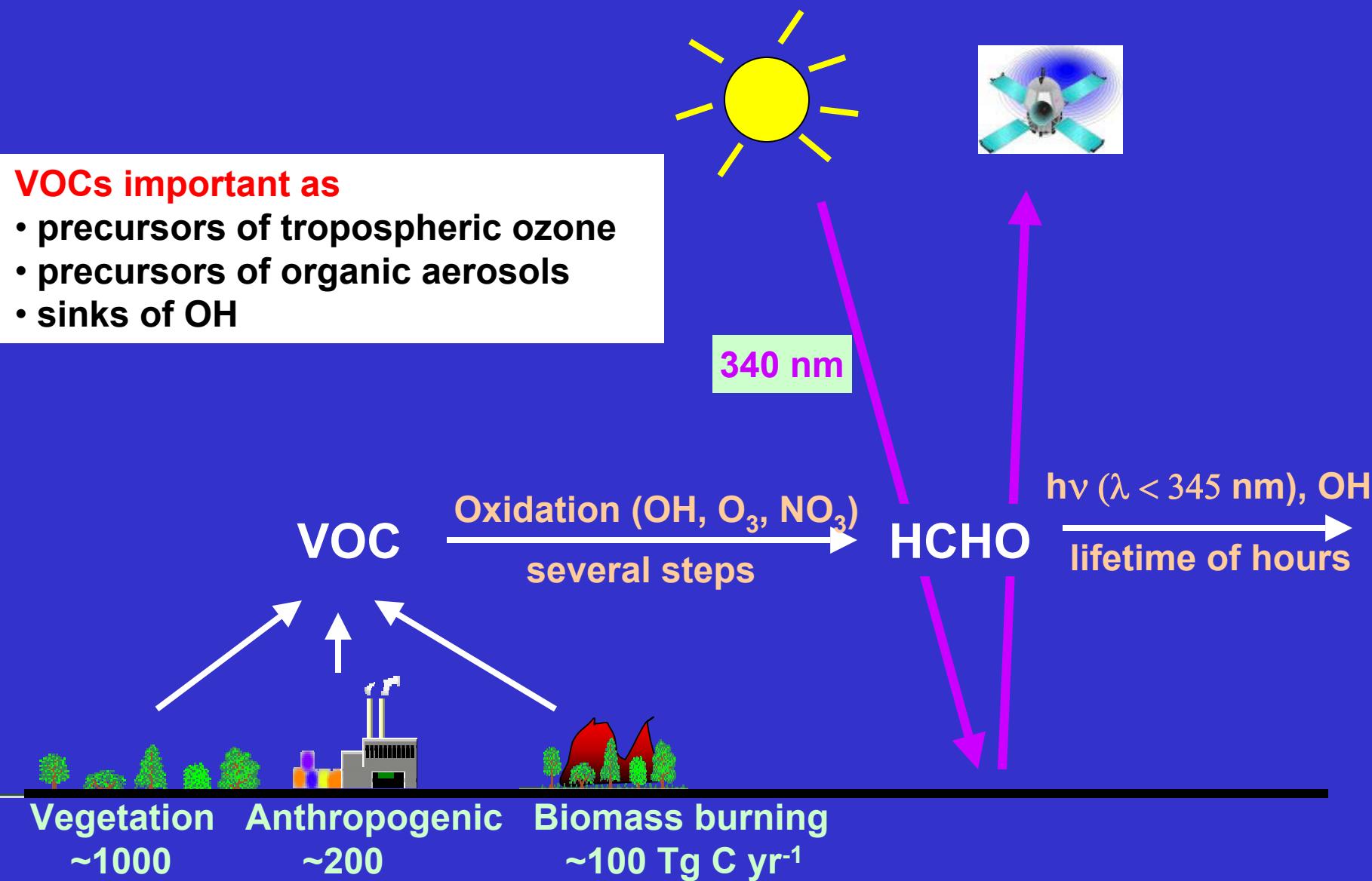
MAPPING ISOPRENE EMISSIONS FROM SPACE USING OMI FORMALDEHYDE MEASUREMENTS

Dylan B. Millet, Daniel J. Jacob, K. Folkert Boersma, Justin P. Parrella
Atmospheric Chemistry Modeling Group, Harvard University
Thomas Kurosu and Kelly V. Chance
Harvard/Smithsonian Center for Astrophysics
Brian G. Heikes (URI), Alan Fried and Alex B. Guenther (NCAR),
Colette L. Heald (Berkeley)

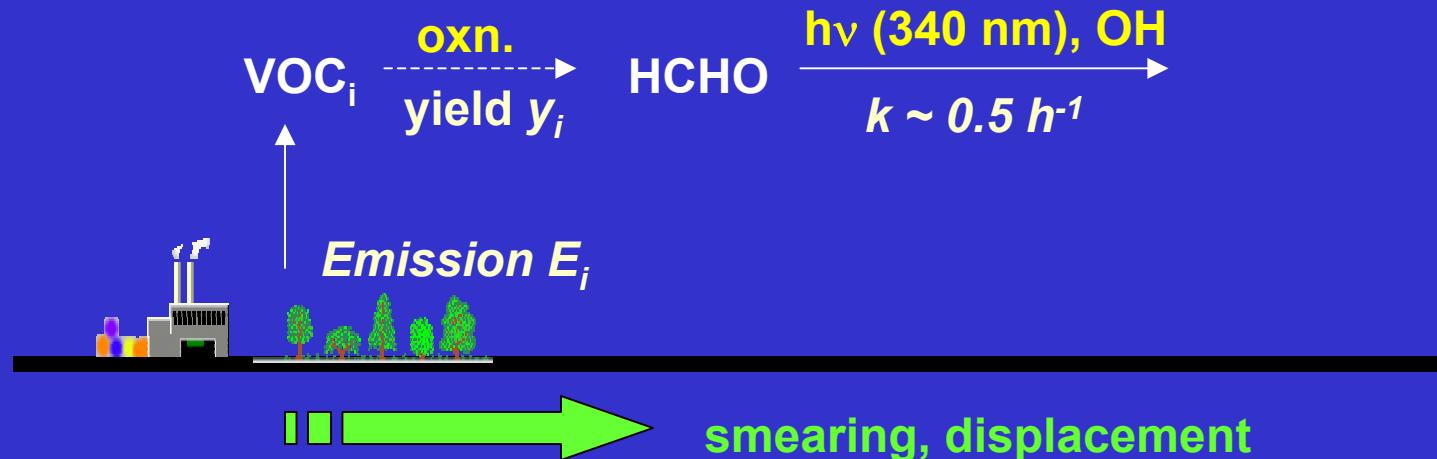
Work supported by NASA/ACMAP



SPACE-BASED MEASUREMENTS OF HCHO COLUMNS OFFER CONSTRAINTS ON VOLATILE ORGANIC COMPOUND (VOC) EMISSIONS



RELATING HCHO COLUMNS TO VOC EMISSION

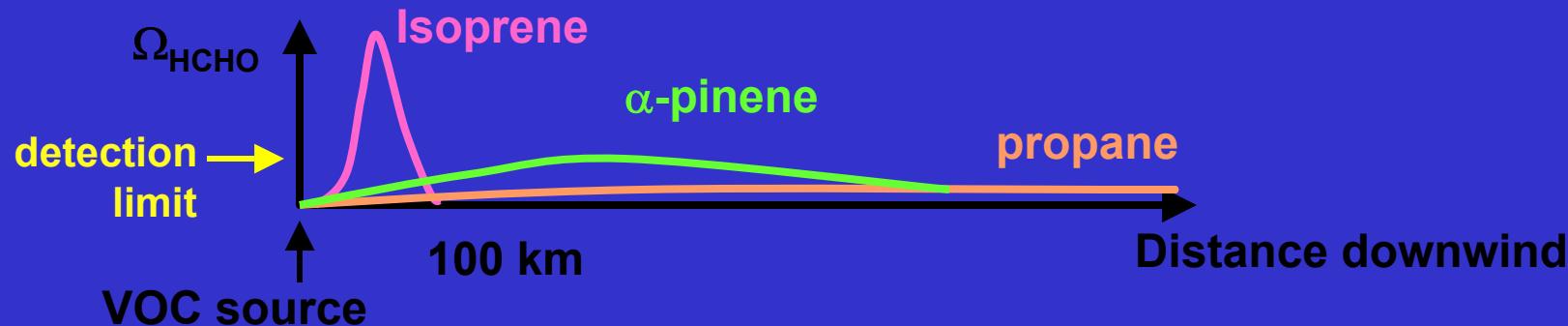


In absence of horizontal wind, mass balance for HCHO column Ω_{HCHO} :

$$\Omega_{\text{HCHO}} = \frac{\sum_i y_i E_i}{k}$$

Local linear relationship between HCHO and E

... but wind smears this local relationship between Ω_{HCHO} and E_i depending on the lifetime of the parent VOC with respect to HCHO production:



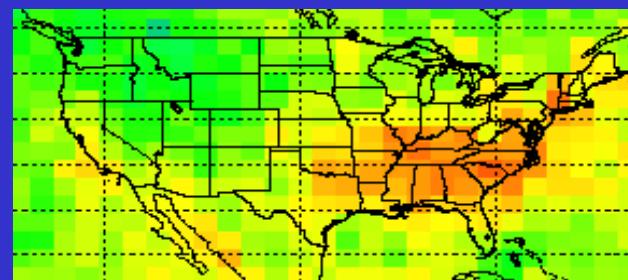
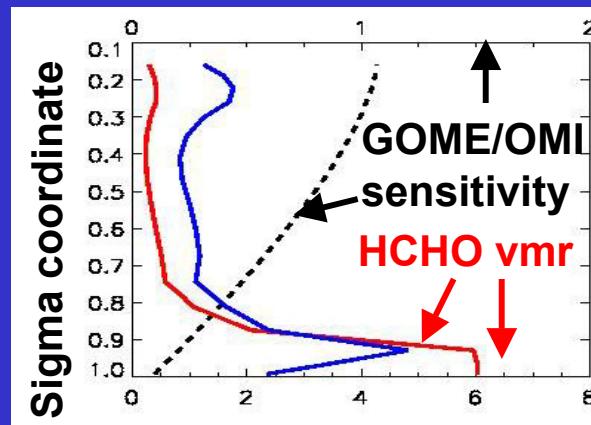
INVERTING HCHO COLUMN DATA FOR ISOPRENE EMISSION

Palmer et al. [2001, 2003, 2006]

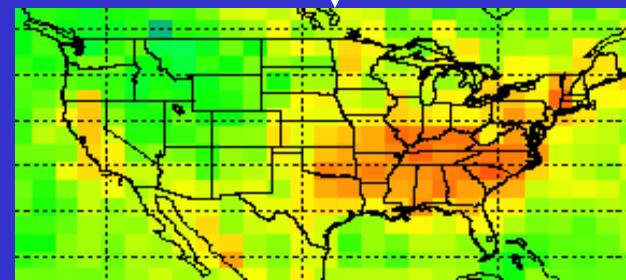
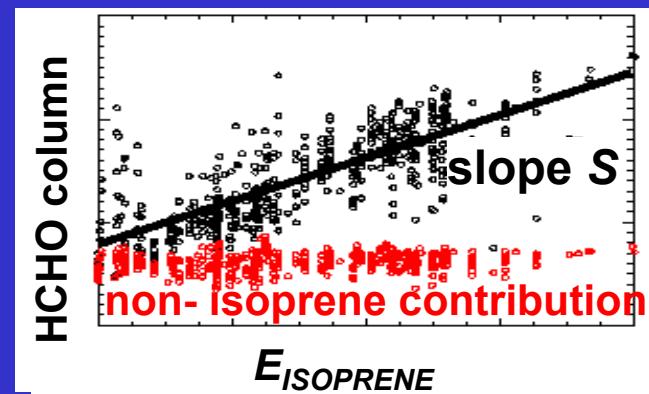
with
bottom-up
isoprene
emission
inventory

GEOS-Chem
chemical
transport
model

with GOME
isoprene
emission
inventory



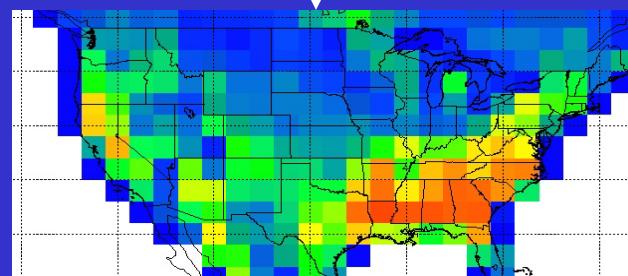
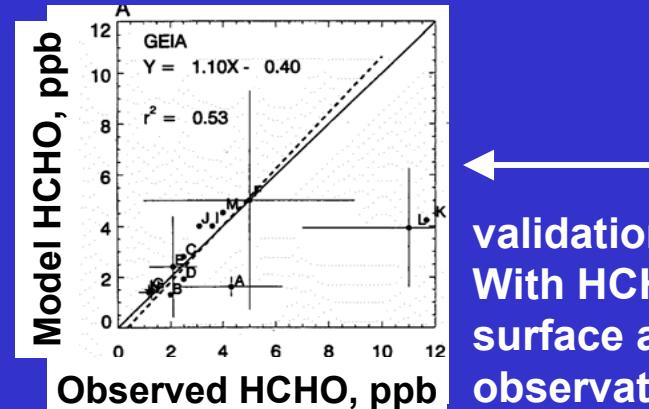
GOME
slant
columns
(July 96)



GOME
vertical
columns
(July 96)

Air Mass Factor

$$E_{\text{ISOPRENE}} = (1/S)\Delta \Omega_{\text{HCHO}}$$



GOME
isoprene
emission
inventory

MEGAN EMISSION INVENTORY FOR BIOGENIC VOCs

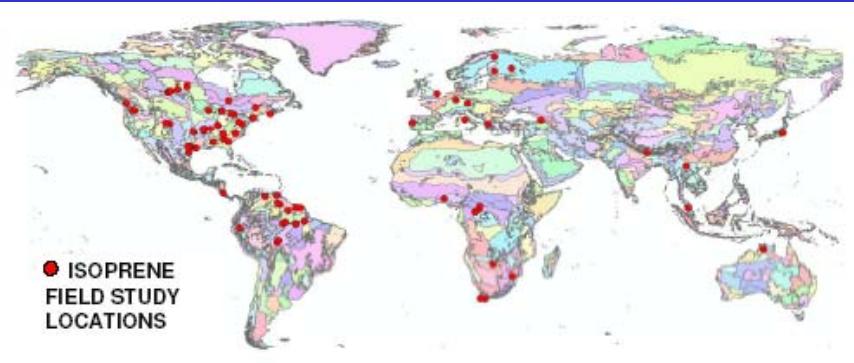
Atmos. Chem. Phys., 6, 3181–3210, 2006
www.atmos-chem-phys.net/6/3181/2006/
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Atmospheric
Chemistry
and Physics

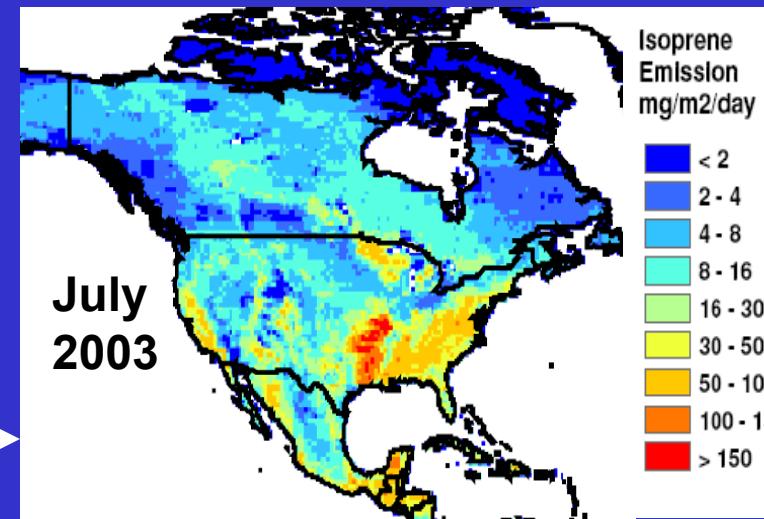
Estimates of global terrestrial isoprene emissions using MEGAN (Model of Emissions of Gases and Aerosols from Nature)

A. Guenther¹, T. Karl¹, P. Harley¹, C. Wiedinmyer¹, P. I. Palmer², and C. Geron³



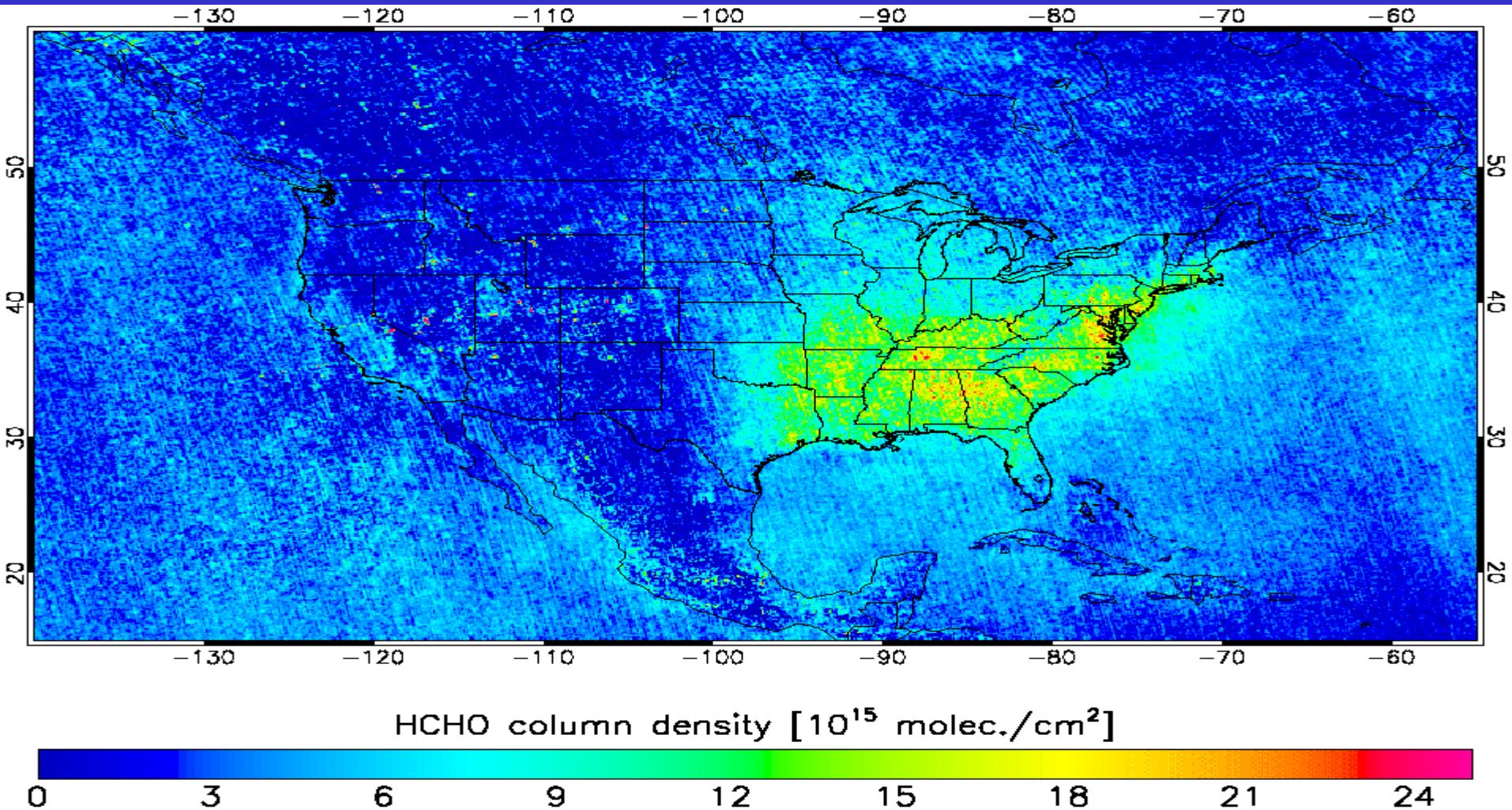
Environmental factors:

- temperature
- solar irradiance
- leaf area index
- leaf age



OMI HCHO COLUMNS (Jul-Aug 2005)

	OMI	GOME
Pixel resolution	13x24 km ²	80x320 km ²
Return time	1 day	3 days

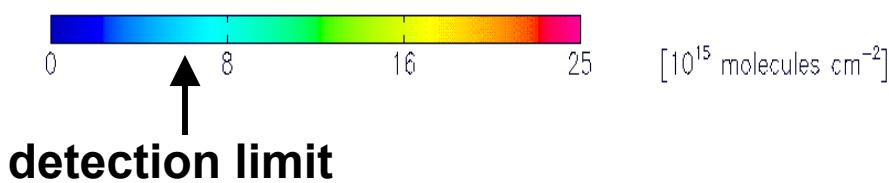
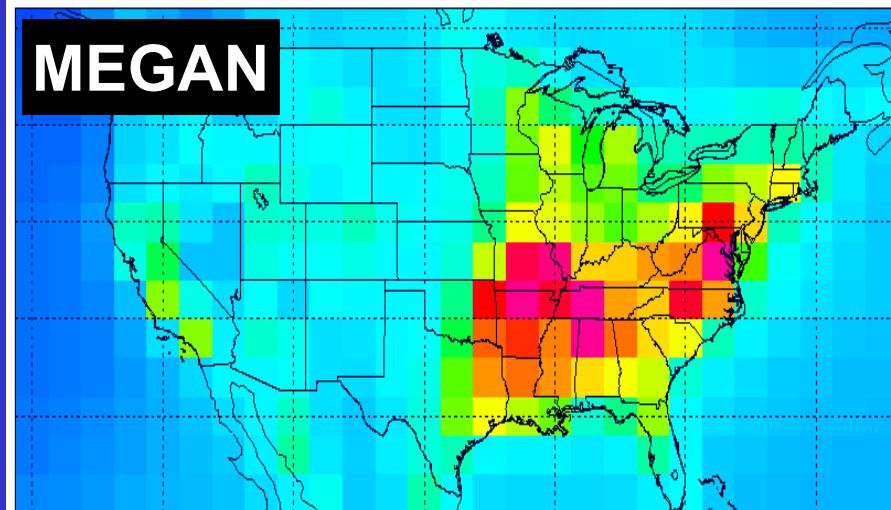
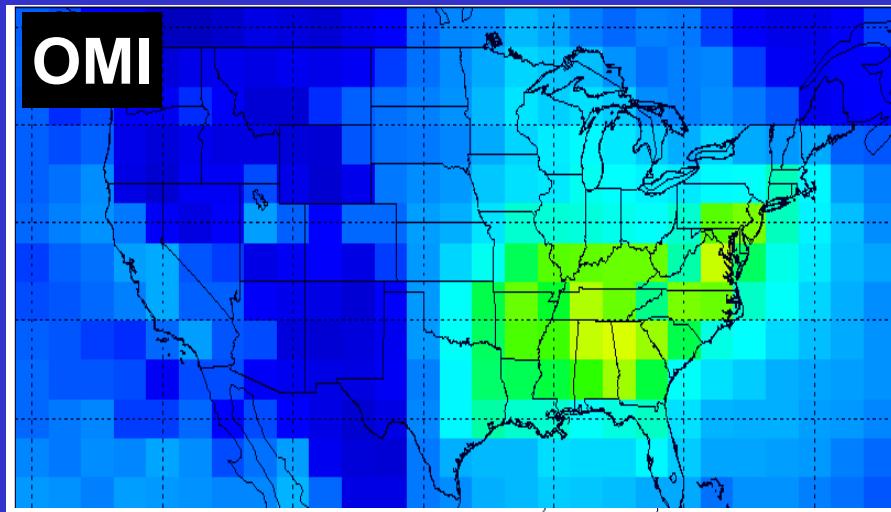
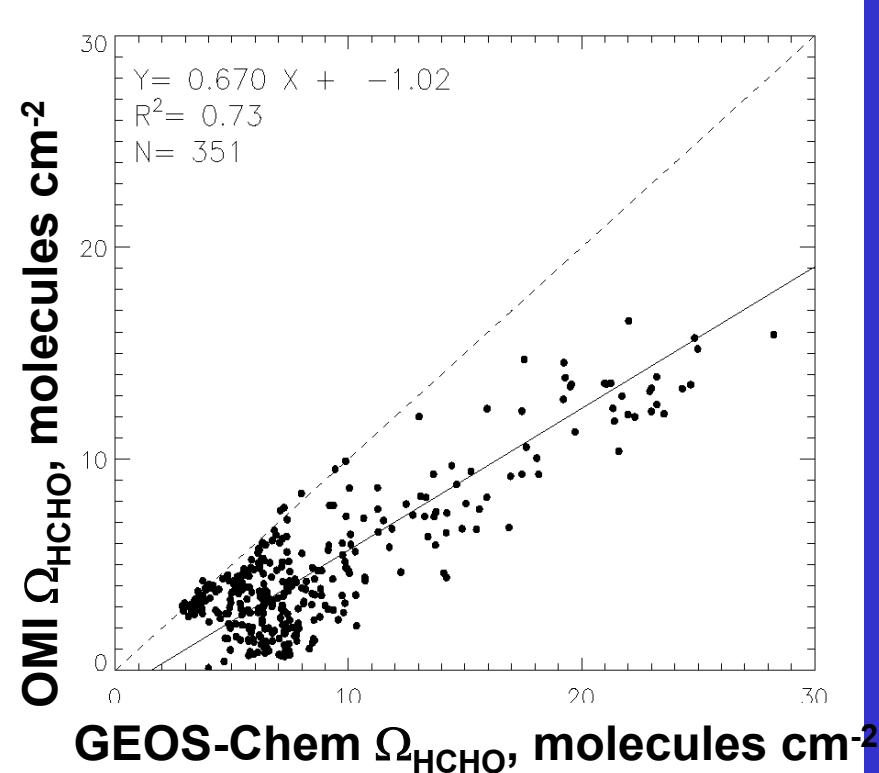


Thomas Kurosu, Harvard-SAO

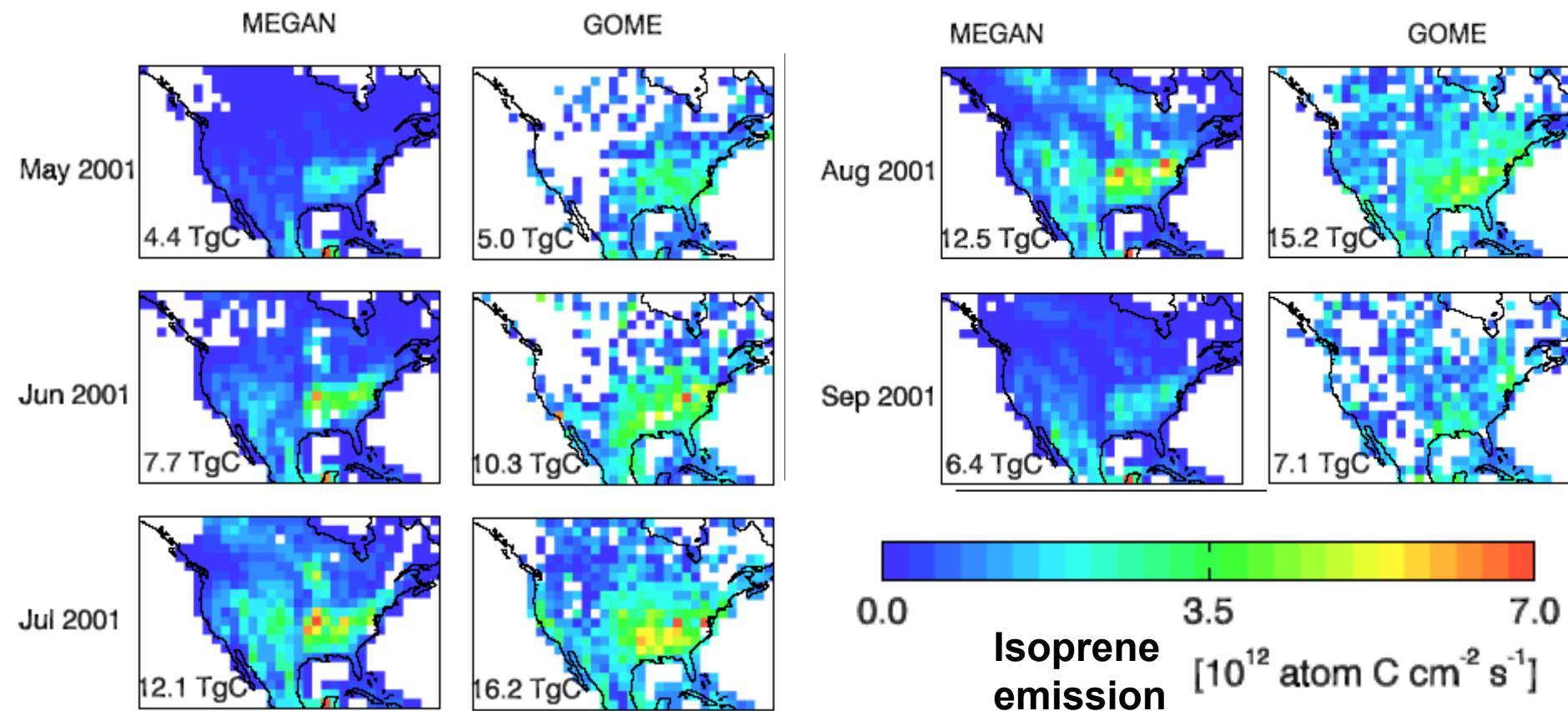
OMI vs. GEOS-Chem/MEGAN HCHO COLUMNS

Jul-Aug 2005

OMI is 35% lower
than GEOS-Chem/MEGAN

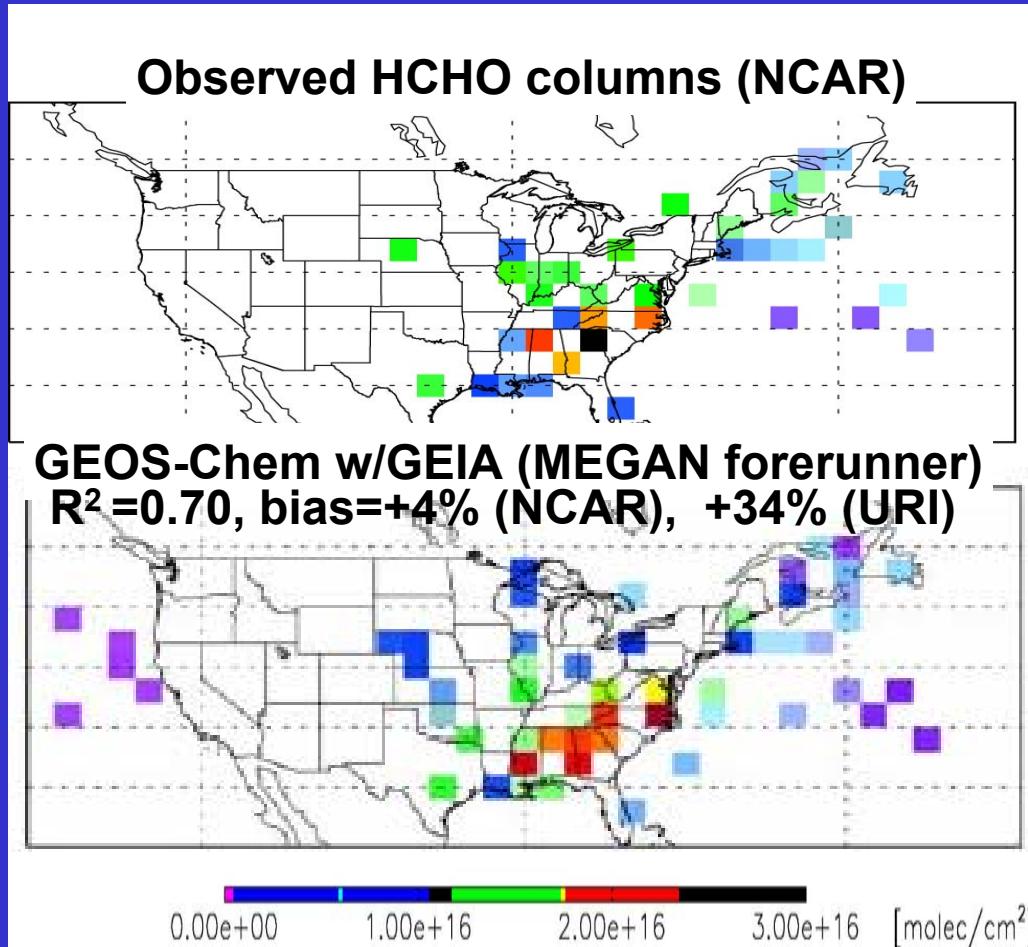


In contrast, GOME was 10-30% higher than GEOS-Chem/MEGAN!

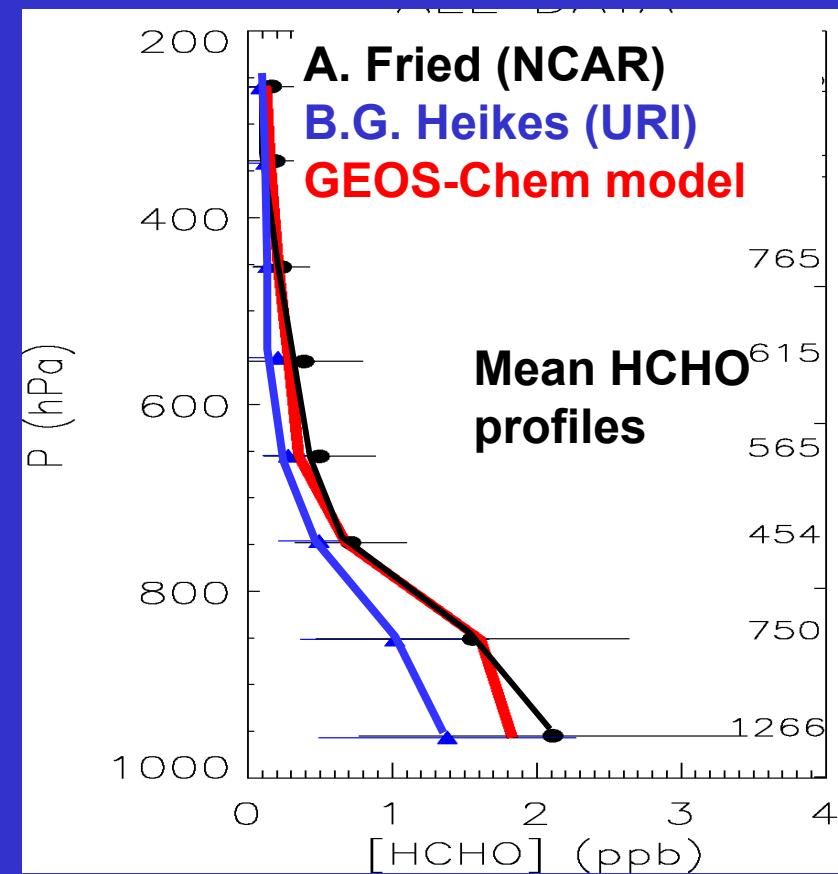


USING INTEX-A AIRCRAFT DATA AS ARBITER

DC-8 0-10 km HCHO profiles over N. America (summer 2004)



MEGAN is on average 10% lower than GEIA

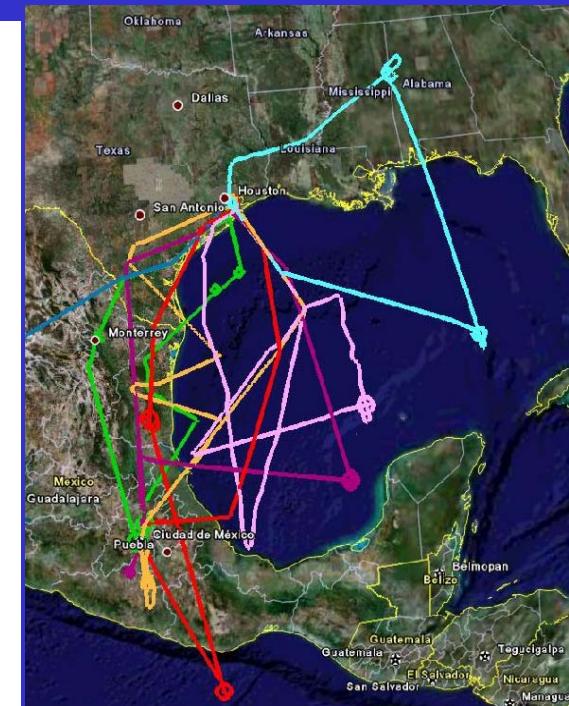
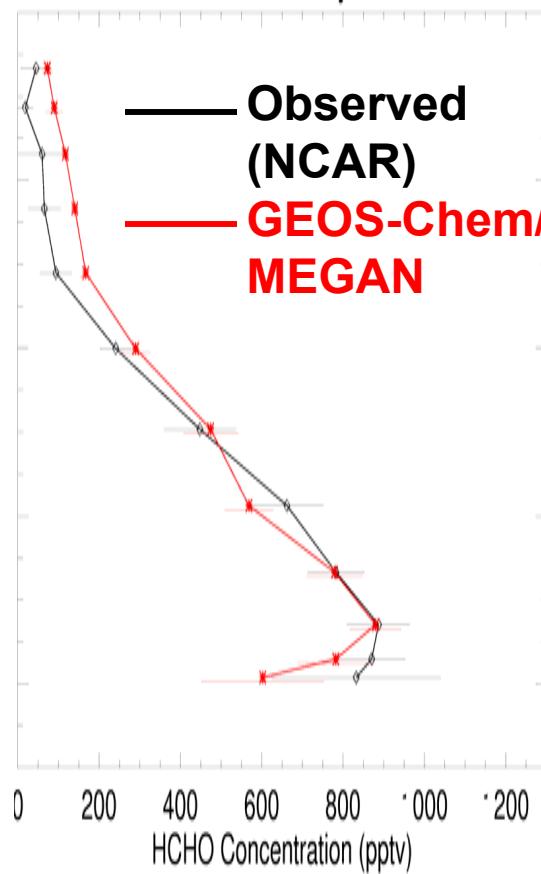
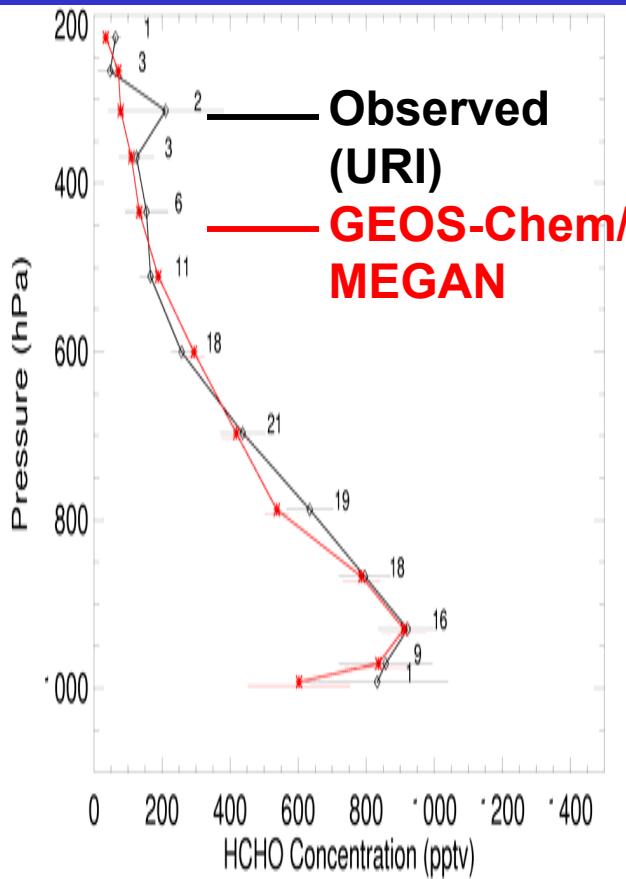


Millet et al. [in press]

GEOS-Chem EVALUATION w/ INTEX-B/MILAGRO DATA

March 2006

URI and NCAR measurements now agree and also agree with GEOS-Chem

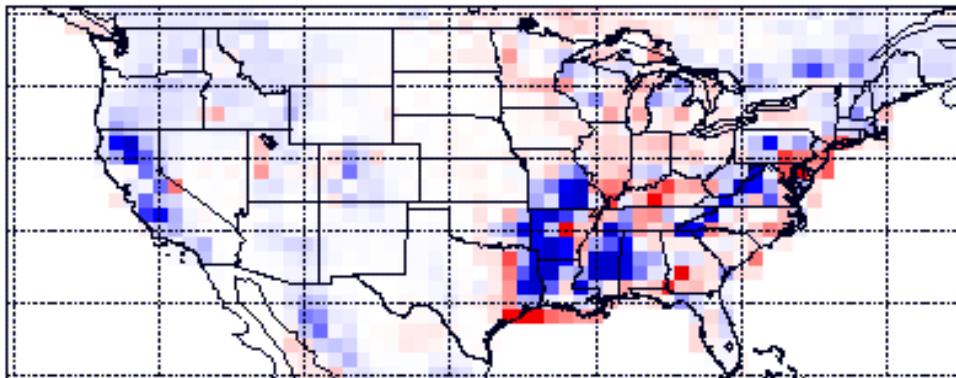


*Justin P. Parrella,
Harvard*

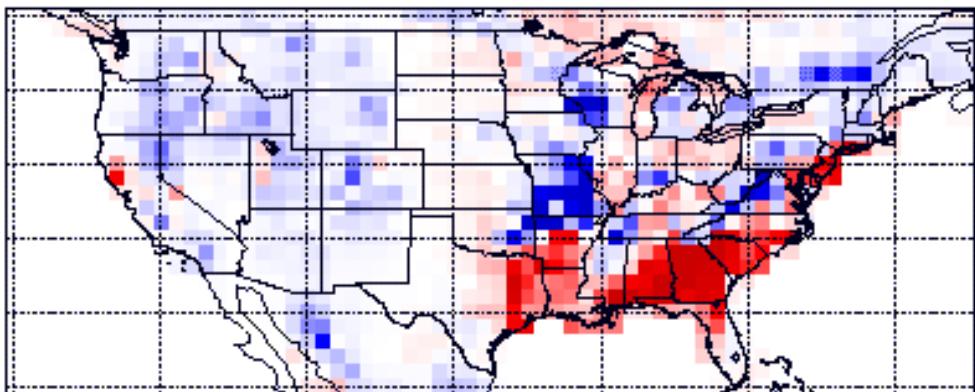
SPATIAL PATTERNS IN OMI vs. MEGAN DISCREPANCIES

NORMALIZED OMI – MEGAN (Jul-Aug 2005)

MEGAN w/Olson [2001] data base



MEGAN w/ Community Land Model (CLM)



- Scale up OMI to remove overall bias;
- Drive MEGAN with two different land surface data bases

- Large sensitivity of MEGAN to choice of land data base!
- MEGAN higher than normalized OMI in Missouri (Ozarks), lower than OMI in deep South and along southeast Atlantic

Dylan B. Millet [Harvard]
and Colette L. Heald [Berkeley]

WHY IS MEGAN SO HIGH OVER OZARKS AND VIRGINIA?

Oak tree cover, high temperatures

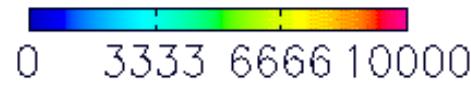
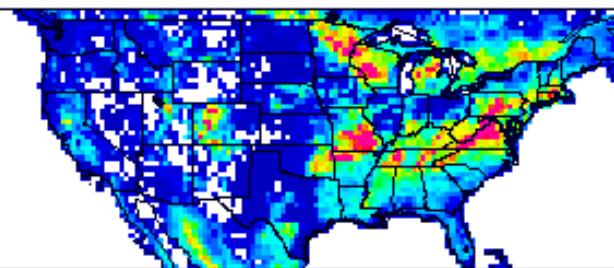
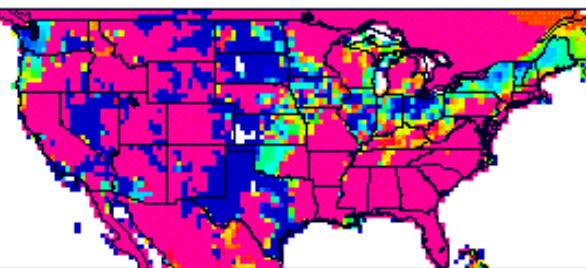
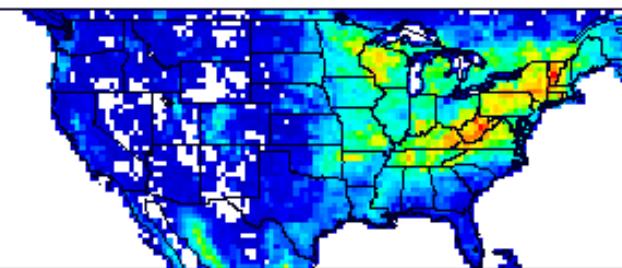
CLM land cover

Broadleaf trees

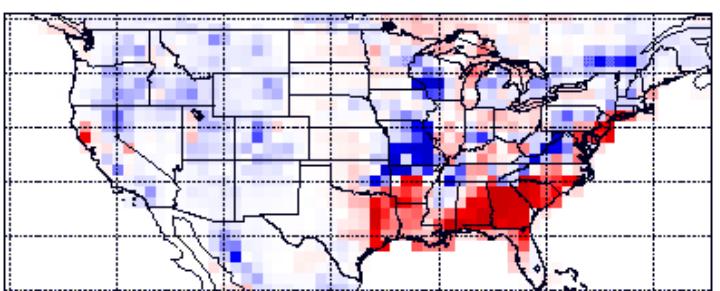
Emission factor (EF)

EF

EF * Coverage



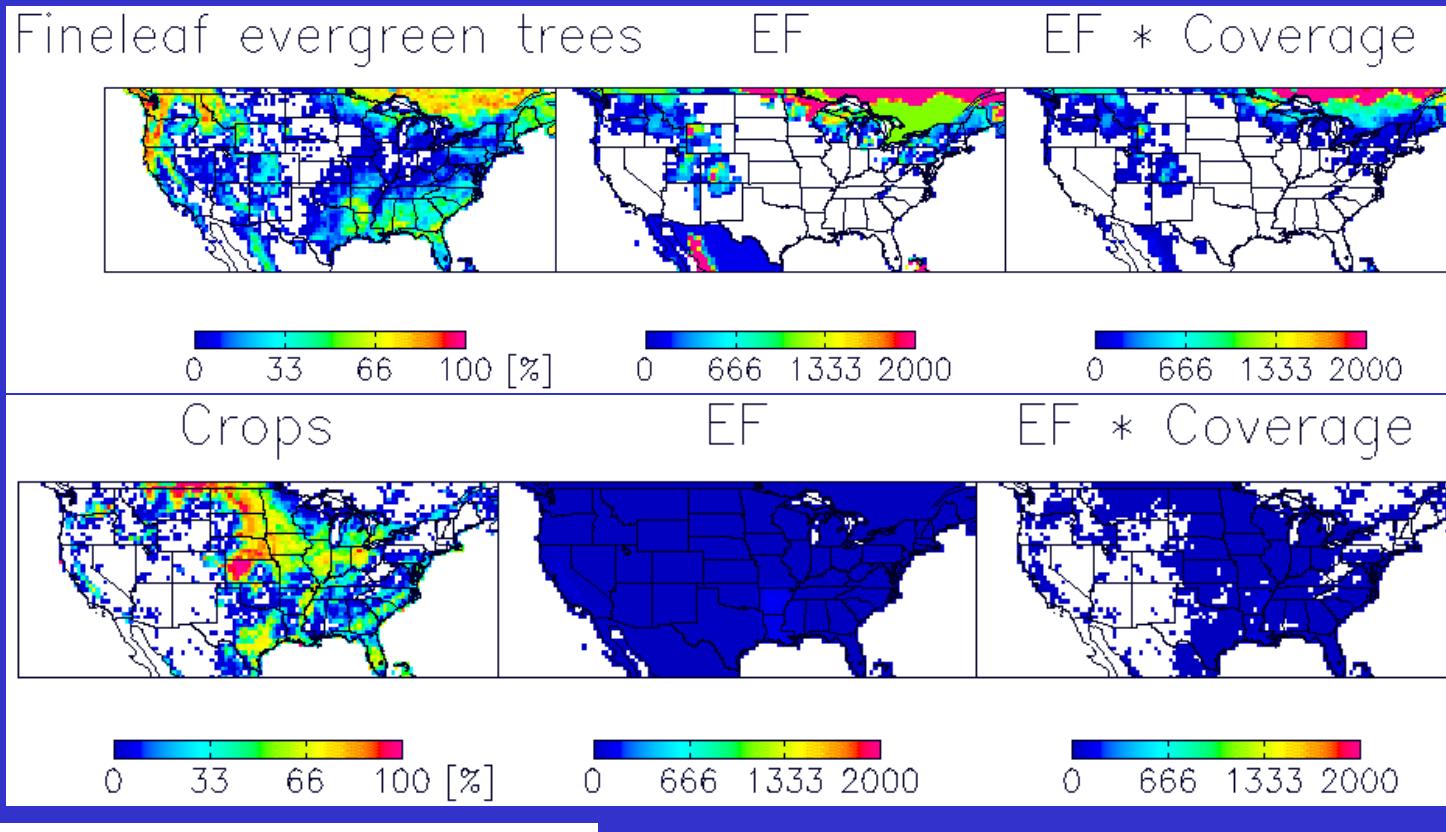
Normalized OMI – CLM



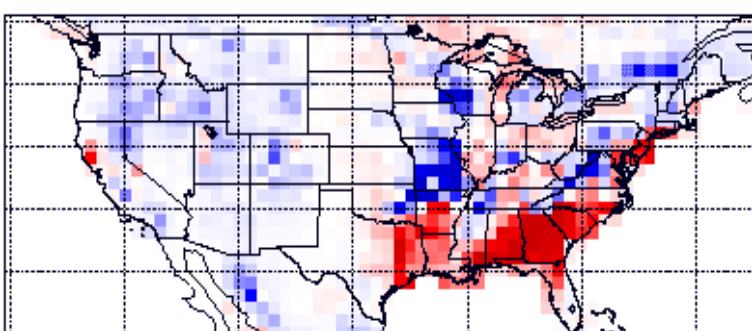
Comparison with OMI suggests that emissions from broadleaf trees are overestimated

WHY IS MEGAN LOW IN DEEP SOUTH AND ATL. COAST?

CLM land cover



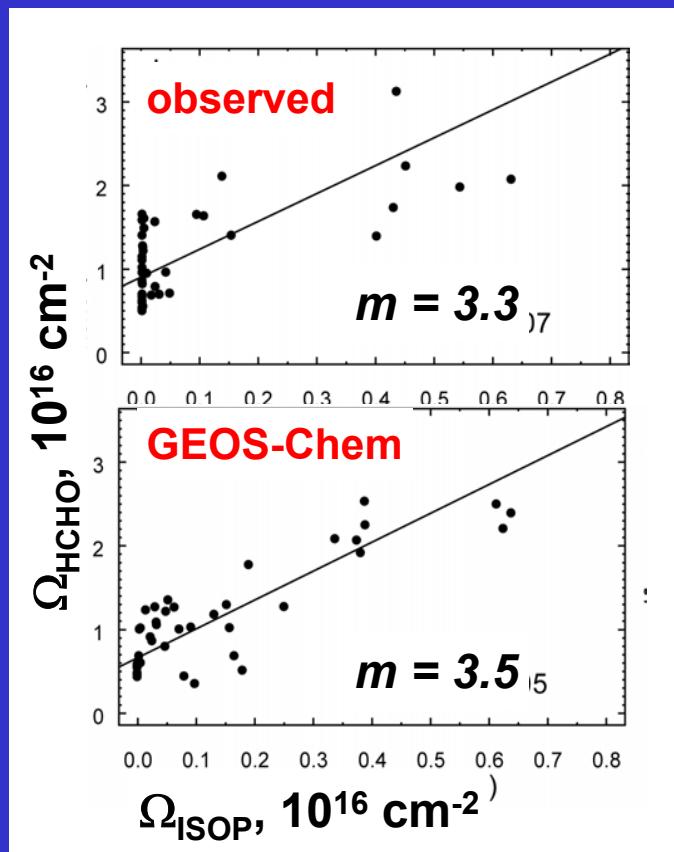
Normalized OMI – CLM



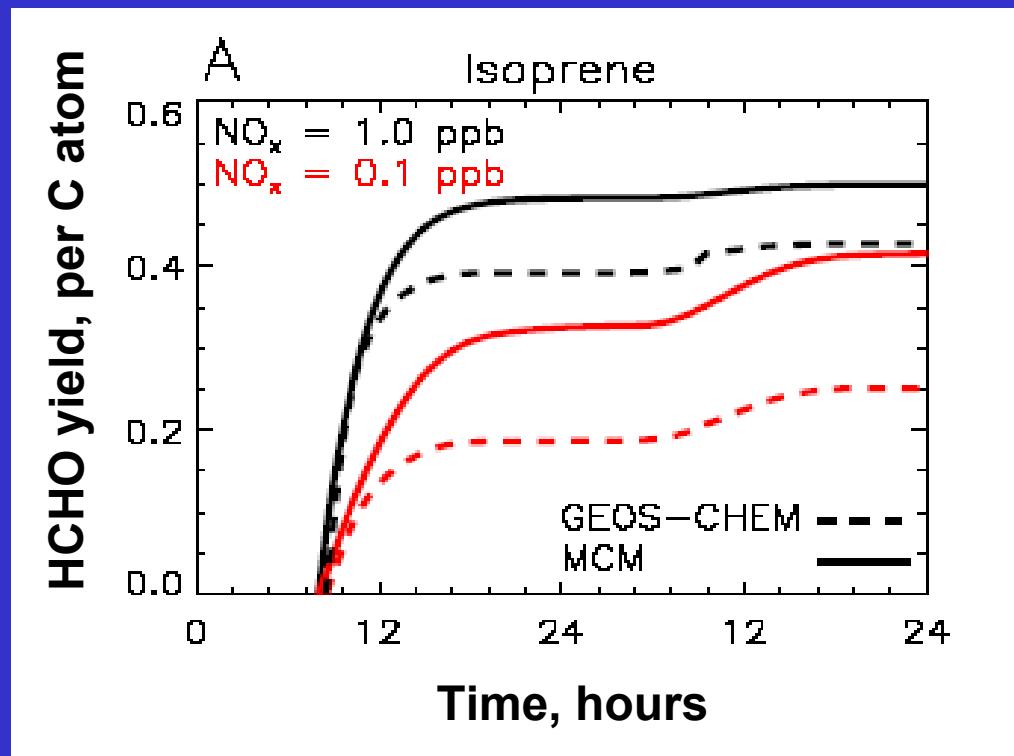
- suggests underestimate of pine emissions In southeast
- also suggests underestimate of emissions by cotton and peanuts, the two regional crops

TEST GEOS-Chem HCHO YIELDS FROM ISOPRENE WITH INTEX-A AIRCRAFT DATA

HCHO vs. isoprene columns
in INTEX-A



Box model simulations:
GEOS-Chem and MCM v3.1 mechanisms



Estimate yield uncertainty of ~20%, greater in low- NO_x regime